

TITLE OF THE INVENTION  
VEHICLE ROOF

5 BACKGROUND INFORMATION

The invention relates to a vehicle roof, comprising an opening roof panel, which can be moved from a first, closed roof position into a second, fully opened roof position, the roof panel being held essentially parallel to the rest of the vehicle roof and at a distance from the rest of the vehicle roof in the second  
10 roof position, and a lateral guide, the roof panel being guided at least during a part of an opening movement on the guide

In modern vehicle construction there is a demand for roofs that can be partially opened, giving the largest possible roof opening. This affords the vehicle user  
15 driving pleasure comparable to that obtainable with the roof of a full convertible without the disadvantages associated with roofs of such convertibles.

DE 42 38 944 C1 describes a vehicle roof that can be opened and in which an extensive roof panel in a rear area is guided by means of guide pins in guides  
20 which are formed in a roof luggage rail. When opening the roof, the roof panel can first be moved by means of a deployment lever into an intermediate position raised at the rear in which the roof panel assumes an inclined position. On reaching the intermediate position, the roof panel can be displaced into a fully opened position toward the rear of the vehicle, the inclination of the roof  
25 panel being maintained. This has the disadvantage that the inclination of the roof panel fundamentally prevents the roof panel being displaced by its full length. The proposed solution to this, however, which involves disengaging the deployment lever from the roof panel in the course of the roof opening sequence in order to achieve the greatest possible travel, can also impair the  
30 reliability of the drive mechanism due to the increasing mechanical tolerances that occur in use. Furthermore, the proposed vehicle roof does not permit additional positions of the roof panel such as a raised, opened position parallel to the rest of the roof.

35 DE 42 27 400 C2 describes an opening roof part guided on a guide rail which is formed in the manner of a roof rail, parts of a driving device for the roof part being arranged outside a sealed inner space of the vehicle even with the roof

part closed, hence those parts of the driving device being unprotected from weather impact.

5 DE 195 25 839 C1 describes an an opening roof part guided on a guide rail which is formed in the manner of a roof rail, it beeing impossible to move the roof part by ist entire length due to an inclined position of the roof part.

#### SUMMARY OF THE INVENTION

10 An object of the invention is to specify a vehicle roof in which a maximum and at the same time versatile opening of the roof can be achieved.

This and other objects are achieved by the invention.

15 A vehicle roof according to the invention comprises an opening roof panel, which can be moved from a first, closed roof position into a second, fully opened roof position, the roof panel being held essentially parallel to the rest of the vehicle roof and at a distance from the rest of the vehicle roof in the second roof position; a lateral guide, the roof panel being guided at least during a part of an opening movement on the guide; a third, partially opened roof position in  
20 which the roof panel is held in a position that is essentially inclined with respect to the rest of the vehicle roof, rising counter to the direction of travel; and an elevating means for elevating a front edge area of the roof panel.

25 This achieves the advantage that any inclination of the moveable roof panel does not restrict its travel when it is run from the closed position into the fully opened position, so that an especially large roof opening is ultimately possible. A means of elevating a front edge area of the roof panel is provided, so that by operating the elevating means the roof panel can assume a position parallel to the rest of the roof and at a distance therefrom.

30 In a preferred embodiment, the roof panel is a dvantageously connected to a first slide element moveably a ccommodated i n a guide rail and the e levating means comprises a telescopic guide and a control lever having a slotted link and pivotally connected to a second slide element, so that the front edge area  
35 of the roof panel can be elevated by simple mechanical means. In particular, the elevation of the front edge area can be accomplished in that the roof panel is forcibly carried by a movement of the first slide element in relation to the

second slide element, the second slide element being releasably held by means of a catch lever and capable of being releasably fixed to the first slide element by means of a coupling element.

5 In a particularly preferred embodiment of the present invention a fourth, partially opened roof position is furthermore provided, in which the roof panel is held in a position essentially parallel to the rest of the vehicle roof and at a distance from the rest of the vehicle roof. This creates, in addition to the third, inclined position, a ventilation position of the roof, which is available as an alternative  
10 depending on the road speed and weather conditions.

The lateral guides are formed, for particular preference, on rail elements which stand proud of a surface of the vehicle roof in the manner of roof luggage rails. This represents a simple way of ensuring a significant lift of the roof panel in its  
15 rear end area whilst ensuring a secure guide and mounting.

A guide element supporting the roof panel on the guides and moveable in the guides is preferably moveable in relation to the roof panel. The rear end area of the roof panel can thereby be easily raised by movement of the guide elements,  
20 without the need to move the roof panel itself rearward.

An especially preferred embodiment of a vehicle roof according to the invention comprises a guide element which is assigned to the lateral guides and can be moved in relation to the roof panel by means of a push rod, a simple actuation  
25 of the push rod for elevating a rear edge area of the vehicle roof preferably being achievable in that the push rod is operatively connected to the first slide element.

In order to achieve automatic driving of the vehicle roof, the first slide element  
30 can advantageously be driven in particular by a Bowden cable that is capable of transmitting both push and pull forces.

In a preferred embodiment of a vehicle roof according to the invention a further, non-opening, transparent roof element is arranged behind the roof panel, so  
35 that an especially large overall roof area is transparent.

A vehicle roof according to the invention preferably has a driveable, opening anti-glare device, which for particular preference comprises a first driveable reel and a second driveable reel. In this way multiple sections of the vehicle roof can be separately covered or exposed.

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In an especially preferred embodiment of a vehicle roof according to the invention a pivotable wind deflector is furthermore provided on the vehicle roof so that air vortices in the area of the opened roof and corresponding wind noises are effectively reduced. Raising of the wind deflector can preferably be controlled automatically by an opening movement of the roof panel. In an especially simple and therefore advantageous embodiment the wind deflector is operatively connected to a control lever, the control lever at the same time driving the roof panel when raising it. In a simple mechanical embodiment the control lever can be disengaged from the wind deflector when opening the roof panel.

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Further advantages and features of the vehicle roof according to the invention are set forth in the example of an embodiment described below and in the dependent claims.

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A preferred example of an embodiment of a vehicle roof according to the invention is described below and explained in more detail with reference to the drawings attached.

## 25 BRIEF DESCRIPTION OF THE DRAWINGS

- Fig. 1 shows a schematic, perspective top view of a vehicle roof according to the invention in a fully opened position.
- Fig. 2 shows the vehicle roof of Fig. 1 in a partially opened position.
- 30 Fig. 3 shows a perspective view of guide rails for the vehicle roof of Fig. 1.
- Fig. 4 shows a perspective view of a part of a drive mechanism for the vehicle roof according to the invention in a closed position.
- Fig. 5 shows a perspective view of a part of the drive mechanism of Fig. 4 omitting some components.
- 35 Fig. 6 shows a rear perspective view of the drive mechanism of Fig. 5.
- Fig. 7 shows a plain view of the drive mechanism of Fig. 5 from the side.

Fig. 8 shows the drive mechanism in Fig. 7 in an inclined ventilation position.

Fig. 9 shows the drive mechanism of Fig. 7 in a fully opened position.

Fig. 10 shows a perspective, detailed view of a guide element for guiding a rear edge area of the opening roof panel.

Fig. 11 shows a view of an anti-glare device, in the form of a two-part reel, for the vehicle roof.

#### DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The vehicle roof according to the invention comprises a moveable, opening roof panel 1, which is preferably composed of glass or a transparent plastic and is arranged in front of a likewise transparent, non-opening roof element 2 when the roof is in a closed position. The roof panel 1 comprises a support element 1a, preferably composed of metal, to which it is fixed by means of fasteners.

In the vehicle longitudinal direction the mechanism of the vehicle roof is of essentially symmetrical design on each of the two vehicle sides, so that only one side will be described.

The support element 1a of the roof panel 1 is essentially designed as a profiled rail with a push rod 3, which is moveably guided in the support element 1a, passing through it. A guide element 3a, which is accommodated and guided so that it can slide in a lateral guide 4a of a rail element 4 in the form of a roof luggage rail, is formed at a rear end of the push rod 3. The rail element 4 comprises a rear rail area 4b, in which the guide 4a runs straight and essentially horizontally, and a centre foot 4c, in which the guide 4a assumes an inclined path and in the closed state terminates in a rear end area of the roof panel 1. Fig. 10, in particular, shows that the guide element 3a can be moved by the push rod 3 inside a recess 3b provided in the support element 1a.

A front end area of the support element 1a is articulated at one end of an elongate control lever 5. The control lever 5 has a multiply woundly slotted link 5a, which is formed as a slotted opening in the control lever 5.

A first slide element 6 has a link pin 6a, which engages in the slotted link 5a of the control lever 5. At its end opposite the articulation of the support element 1a, the control lever 5 is articulated on a second slide element 7.

A lower half 8a of a telescopic guide 8 is fixed to the first slide element 6. An upper half 8b of the telescopic guide 8 is accommodated on the lower half 8a so that it is displaceable in an essentially vertical direction in relation to the latter. The upper half 8b of the telescopic guide 8 is articulated on a front end of the push rod 3 projecting from the support element 1a that guides the push rod 3. In total, the telescopic guide 8 with its connected parts forms out an elevating means 5, 6, 7, 8 for elevating a front region of the roof panel 1. This elevating means is independent from the rail element 4 which is responsible for an elevation of a rear region of the roof panel 1. Thereby the elevating means 5, 6, 7, 8 according to the invention as well as the driving cables, driving motors (not shown) and major parts of the roof mechanism can be arranged such that those parts are not exposed to weather influence in a closed state of the roof panel 1. In the closed state, those parts are arranged within the inner space of the vehicle with respect to seals of the roof part.

Both the first slide element 6 and the second slide element 7 are each held in a guide rail 9 aligned essentially in a horizontal direction. The guide rail 9 is profiled so that the slide elements 6, 7 are each moveable in the longitudinal direction of the rail, the first slide element 6 being arranged in front of the second slide element 7 in the direction of travel. On lateral areas of a roof opening corresponding which corresponds to the roof panel 1, the guide rail 9 is immovably fixed in relation to the rest of the vehicle body.

A bearing bracket 10 is immovably fixed to the guide rail 9, the bearing bracket being situated in front of the second slide element 7 in the direction of travel. A catch lever, which with a hook-shaped end 10a can engage in a corresponding extension 7a of the second slide element, is articulated on the bearing bracket 10. The catch lever 10 moreover has a cam 10b, which is capable of interacting with a corresponding extension of the first slide element 6.

An essentially hook-shaped coupling element 11 is articulated on the second slide element 7, a hook-shaped end of the coupling element 11 being capable of interacting with a corresponding recess of the first slide element 6.

A raisable wind deflector 13 is arranged in front of the roof panel 1 in the direction of travel and is articulated on the body of the vehicle or on a front

edge of the roof opening. A wind deflector lever 13a is articulated at one end on the bearing bracket 10, a carrier plate 13b being articulated by way of a guide slot on the other end of the wind deflector lever. The wind deflector lever 13 is in turn connected to the deployment lever 5 by way of a drive block 14, carried  
 5 so that it slides on the former lever.

The first slide element is connected to a driving cable, which is capable of transmitting both push and pull forces, so that the first slide element can be moved along the guide rail 9 driven by the driving cable.

10 In a preferred development of the vehicle roof a driveable, opening anti-glare device is furthermore provided. This anti-glare device comprises a first driveable reel 15 and a second driveable reel 16, which are each provided in reel holders 15a, 16a fitted to the guide rails 9. The reels 15, 16 are carried in  
 15 the guide rails 9.

The invention now functions as follows:

20 With the roof closed, the push rod 3 is maximally displaced in the direction of travel relative to the support element 1a (see Fig. 10), so that the guide elements 3a are at minimum elevation in the area of the centre foot 4c of the roof luggage rail 4.

25 Starting from an arrangement of the mechanism as shown in Fig. 7, in the course of an opening movement of the roof panel 1 the first slide element 6 is now first displaced toward the rear of the vehicle by means of the driving cable fitted to it. Through the interaction of the link pin 6a with the slotted link 5a in the area of a first bend 15a in the slotted link 5a of the control lever 5, the roof panel 1 or the support 1a is slightly elevated in its front edge area, so that the  
 30 roof panel 1 separates from its seals. At the same time a rear edge area of the roof panel 1 is also slightly elevated by the guide element 3a moving slightly upward in the guide 4a of the rail element 4 in the area of the centre foot 4c.

35 Once this slight initial movement section to release the seal has been exceeded, the link pin 3a passes through a straight, level area 15b of the slotted link 5a, the front edge area of the roof panel 1 thereby not being elevated further. At the same time the guide element 3a performs the

remainder of its travel relative to the support element 1a and hence to the roof panel 1 in the recess 3b and a further upwardly inclined part of the guide 4a, so that the roof panel 1 is elevated further in its rear edge area without the roof panel 1 as a whole moving toward the rear of the vehicle. A ventilation position of the roof panel 1 is accordingly attained (see Fig. 8), in which the roof panel is essentially raised in its rear edge area and overall is inclined downward in the direction of travel.

In a further movement of the first slide element 6 counter to the direction of travel, the link pin now passes through a straight, inclined area 15c of the slotted link 5a, as a result of which the control lever 5 forces the front end of the support element 1a and hence the front edge area of the roof panel 1 upward. In the process the telescopic guide 8 connecting the support element 1a and the first slide element 6 is extended.

This also causes the control lever 5, the drive block 14 and the wind deflector lever 13a to execute a lifting movement of the wind deflector 13, the wind deflector 13 being held spring-loaded in its raised position by a coil spring (not shown), once the control lever 5 disengages from the drive block 14, which has an open guide slot, in the further course of an opening movement.

The roof panel 1 is not fully displaced in its entirety toward the rear of the vehicle until such time as an essentially horizontal, elevated position of the roof panel 1 is reached, since the second slide element 7 is still secured by the catch lever 12 as at the start of the opening movement.

In the position shown in Fig. 9 the first slide element 6 finally encounters the second slide element 7, the first slide element previously having run over the cam 12b of the catch lever 12 and elevated the catch lever 12 in order to release the second slide element 7.

Once the two slide elements 6, 7 have together travelled beyond the starting position of the second slide element 7 the coupling element 11 is furthermore released, which thereby engages in a corresponding recess in the first slide element. In the subsequent closing movement of the vehicle roof, this engagement allows the second slide element to be also carried in this direction by the single driven first slide element 6. Attainment of the starting position of



the second slide element 7 during the closing movement again leads to a release of the first slide element due to the coupling element 11 encountering a corresponding stop in the vicinity of the bearing bracket 10.

- 5 The position of the drive mechanism of the vehicle roof according to the invention shown in Fig. 9 therefore corresponds to a fully opened position of the roof panel 1 (see Fig. 1 for example) and also to a partially opened position in which the roof panel 1 has been only partially moved toward the rear of the vehicle and is disposed essentially parallel and elevated in relation to the rest of  
10 the vehicle roof.